THE MALE GENITALIA AND TERMINAL SEGMENTS OF SOME MEMBERS OF THE GENUS *POLYERGUS* (HYMENOPTERA: FORMICIDAE)

James Forbes and Roger W. Brassel
Biological Laboratory, Fordham University, New York 58, N. Y.

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ABSTRACT

The male genitalic valves and terminal segments are described for *P. lucidus* Mayr, *P. rufescens breviceps* Emery, *P. rufescens bicolor* Wasmann, and *P. rufescens umbratus* Wheeler. These structures show differences which are distinctive for each of the species and subspecies studied. The configuration of the subgenital plate together with the middle valve can be used as a means of identification for these species and subspecies of *Polyergus*.

The increase in the number of studies which seek generic and specific differences in the male genitalia and terminal segments of ants gives evidence to the growing use of these structures as criteria for classification. Emery (1895) separated the doryline from the ponerine ants on the basis of the position of the genitalia. In 1896, he classified additional formicid subfamilies, again using the position of the genitalia as a criterion. Since that time, numerous observations have been made of the male genitalia and terminal gastral segments, which have furthered classification. Some of these studies have been concerned with the shapes and positions of the terminal segments and genitalic valves on the intact specimens (Santschi, 1907, 1908; Emery, 1910, 1925). Other studies have shifted the emphasis from position to structure of the genitalic valves and terminal segments dissected from the specimens (Wheeler, 1934; Clausen, 1938; Weber, 1947, 1948, 1950). More recent studies have extended the use of dissected genitalia and the surrounding segments (Borgmeier, 1950, 1955; Bernard, 1956; Krafchick, 1959). In general, differences have been reported which are significant. However, Buren (1958), in connection with his study of the genus *Crematogaster*, states that the differences in the genitalia are so slight as to be useless for species diagnosis.

In this paper, the genitalic valves and the terminal segments of the two species and three subspecies of the genus *Polyergus,* as it is presently constituted, are described. Creighton (1950) discusses the difficulties in classifying the members of this genus. When considering *bicolor* specifically, he states, "I have retained *bicolor* as an eastern race of *rufescens* although I am aware that it is often difficult to separate *bicolor* from *breviceps.* There seems to be nothing except color by which the two races may be distinguished." This study reveals differences which can be used in the classification of these forms.

MATERIALS AND METHODS

The males of *Polyergus lucidus* Mayr were collected from nests in Bergen County, New Jersey during July 1959 by Stanley Forsythe, a Fordham College student. The *P. rufescens breviceps* Emery specimens were collected at Ute Park, New Mexico, July 1952 by Dr. Arthur C. Cole of the University of Tennessee, Knoxville, Tenn. The *lucidus* and *breviceps* specimens were preserved in 70 percent ethyl alcohol. Two dry, pinned specimens, a *P. rufescens bicolor* Wasmann and a *P. rufescens umbratus* Wheeler, were provided by Dr. William S. Creighton from his collection. The former he collected during September 1933 in the Black Hills of South Dakota and the latter during August 1934 in the Uinta Mountains of Utah. The authors are grateful for the specimens which made this study possible.

The posterior portions of the gasters of the dried, pinned specimens were carefully removed and placed in 30 percent ethyl alcohol for four days in order to soften them for the dissection of the segments. At intervals, they were subjected to gentle heating. The posterior ends of the gasters of the preserved specimens were removed under 70 percent ethyl alcohol. Small, round depressions were prepared in a layer of paraffin on the bottom of a Syracuse watch glass. Into these depressions a few drops of a solution of glycerin and 95 percent ethyl alcohol was placed; the glycerin-alcohol solution was in the proportion, three to one. Each of the severed, terminal portions was transferred to a depression. The final separation of the genitalic valves and terminal segments was accomplished here. The valves and segments were next dehydrated in 95 percent ethyl alcohol and mounted in diaphane.

The use of the glycerin-alcohol solution as a dissection medium for these structures has two advantages. Its viscosity tends to hold the segments in position so that, once separated, the minute valves and segments do not drift out of the dissecting field. Thus, they are more readily located for removal and mounting. Also, this solution, when used in small amounts, does not evaporate at an appreciable rate.

The terminology used in this study has been previously employed (Forbes, 1952). A Bausch and Lomb Tri-simplex microprojector was used in preparing the drawings.

Observations

The males of the *Polyergus* species and subspecies studied show some variation in size. The average length of ten *P. lucidus* males was 8.5 mm., that of three *P. rufescens breviceps* was 5.8 mm., while the *P. rufescens umbratus* specimen measured 6.7 mm. and *P. rufescens bicolor* 6.8 mm.

The genitalia projects ventrally from the posterior end of the male gaster. It is inserted between the ninth and the tenth terga and the ninth sternum or subgenital plate and consists of three pairs of valves held together at their proximal ends by the basal ring. This position and arrangement correspond to the typical pattern previously reported for other members of the subfamily Formicinae (Clausen, 1938; Snodgrass, 1941; Forbes, 1952; Krafchick, 1959).

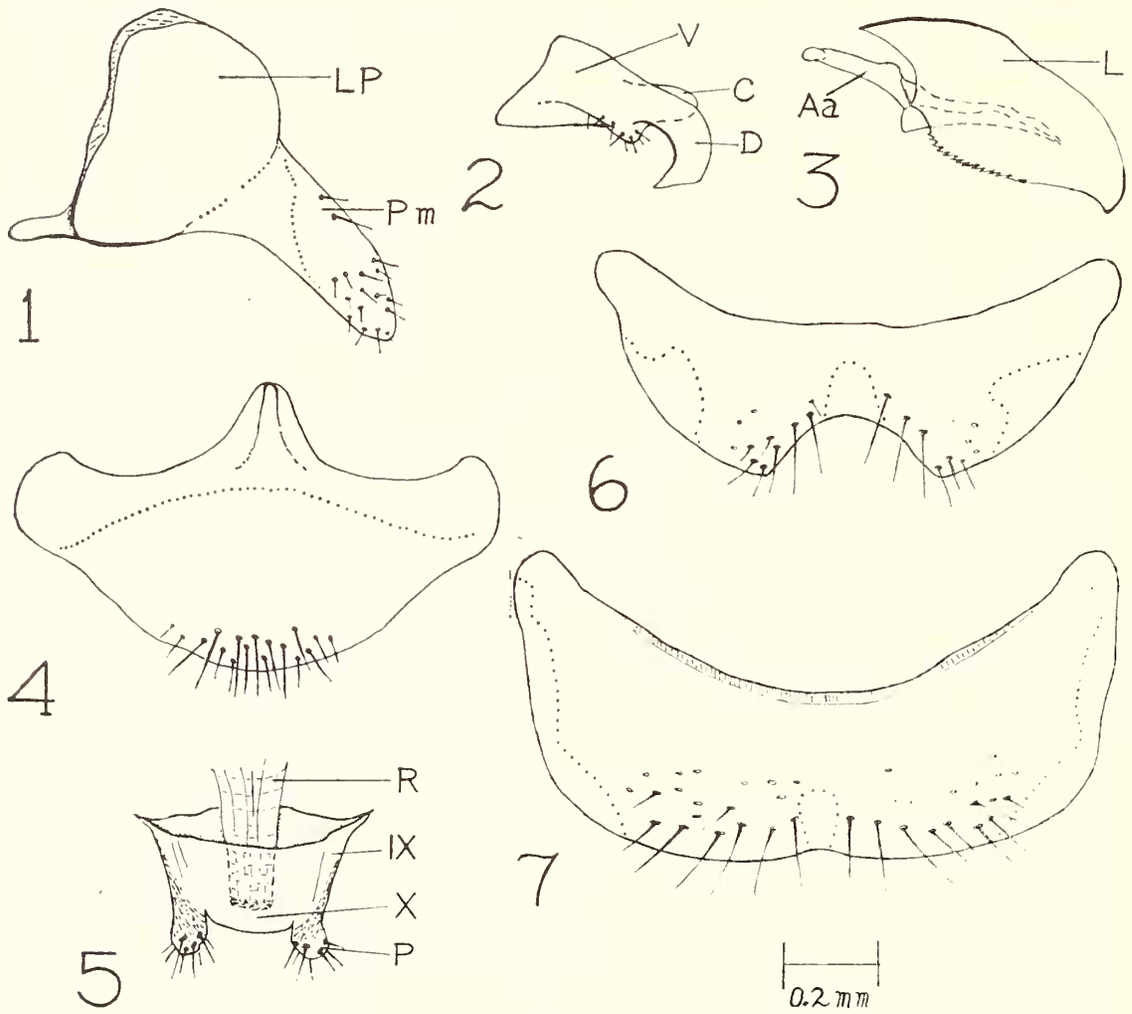
The ninth and tenth terga, the dorsal terminal segments, (fig. 5) are alike in these species and subspecies; perhaps, there are very slight variations in the lengths and shapes of the pygostyles. These segments are unsclerotized except for the lateral margins of the ninth tergum and the pygostyles, which are sclerotized.

The basal ring or lamina annularis, likewise, reveals no differences in shape or sclerotization. It is moderately sclerotized throughout and more heavily sclerotized laterally.

The outer valves consist of a large, laterally convex basal segment, the lamina parameralis, and a narrow, finger-like, distal extension, the paramere (fig. 1). These valves are moderately sclerotized with the exception of a region at the base of the paramere. The position of this unsclerotized region is about the same in the outer valves of all the forms, but its shape varies. The anterior margin of each lamina parameralis is thickened

and more heavily sclerotized. In the three *rufescens* subspecies a small, arciform swelling is present at the base of the paramere on its dorsal or posterior surface; this is lacking on the paramere of *lucidus*. In the figures, the unsclerotized region at the base of the paramere is the area enclosed by the dots. The variation in the shapes of the outer valves is shown in figures 1, 8, 12, and 16.

The middle valves are composed of a basal portion, the lamina



EXPLANATION OF PLATE I

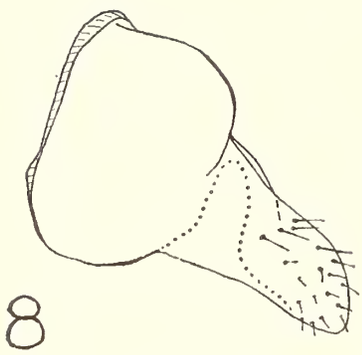
FIGS. 1–5, *Polyergus lucidus*. FIG. 1, Lateral view of outer genitalic valve. FIG. 2, Median view of middle genitalic valve. FIG. 3, Median view of inner genitalic valve. FIG. 4, Ventral view of subgenital plate, the ninth sternum. FIG. 5, Dorsal view of ninth and tenth terga. FIG. 6, Ventral view of eighth sternum of *P. rufescens breviceps*. FIG. 7, Ventral view of eighth sternum of *P. lucidus*. All figures drawn to the scale indicated. Abbreviations: Aa, Aedeagal apodeme; C, Cuspis volsellaris; D, Digitus volsellaris; L, Lamina aedeagalis; LP, Lamina parameralis; P, Pygostyle; Pm, Paramere; R, Rectum; V, Lamina volsellaris; IX, Ninth tergum; X, Tenth tergum.

volsellaris, from which a lateral lobe, the cuspis volsellaris, and a median lobe, the digitus volsellaris, extend distally. The cuspis is the shorter lobe, and its rounded end is directed dorsally or posteriorly. The digitus extends beyond the cuspis and then bends ventrally to form a hook-like projection. Small sensory pegs, the sensilla basiconica, are found on the apposing surfaces of the cuspis and digitus. This middle valve is the most strongly sclerotized of the genitalia and of the terminal segments. It is dark brown or almost black in color, while the other valves and segments are light brown or medium brown in color. The shape of the digitus is significant since it varies for each form in length and curvature (figs. 2, 9, 13, and 17). Further, the angle which the cuspis forms with the valve varies; this may be important.

The inner pair of valves consists of two laterally compressed plates, the laminae aedeagales. These are united dorsally by the weakly sclerotized spatha. Each lamina aedeagalis tapers distally to end in a slightly recurved hook, and its ventral surface or lower edge is partially serrated. These valves are moderately sclerotized. A more strongly, sclerotized aedeagal apodeme is found on the lateral wall and extends anterolaterally. No pronounced differences were observed in these valves (figs. 3, 10, 14, and 18).

The subgenital plate or ninth sternum covers the ventral, anterior portions of the genitalia. It is moderately sclerotized only in its posterior regions. The anterior portions are weakly sclerotized. In the figures, these are the regions above the dotted lines. The anterior, median projections of these segments in *breviceps* and *bicolor* are slightly more heavily sclerotized than in *umbratus* and *lucidus*. The shape of this segment differs markedly for each of the forms studied (figs. 4, 11, 15, and 19).

The eighth sternum, by its position, covers the anterior portion of the subgenital plate. The difference in the shape of the eighth sternum in *lucidus* and *breviceps* is shown in figures 7 and 6; this segment was not available from *umbratus* and *bicolor*. It is moderately sclerotized except on the lateral and ventral median portions, which are weakly sclerotized. In the figures the weakly sclerotized areas are bounded by the dotted lines. In *lucidus* the posterior, median, weakly sclerotized area may be larger in extent than is illustrated. The anterior margin is heavily sclerotized in *lucidus*.



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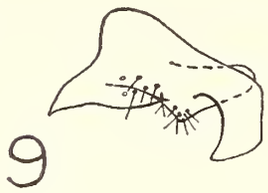

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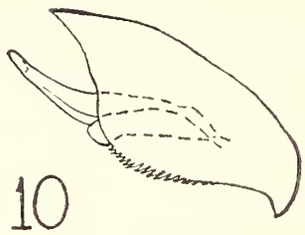

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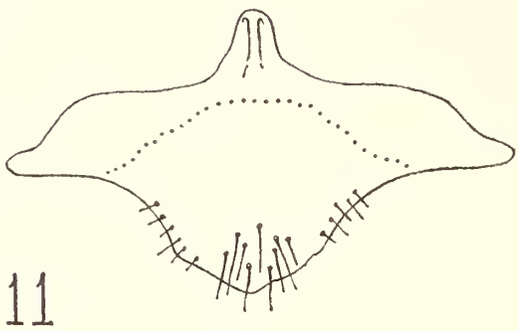

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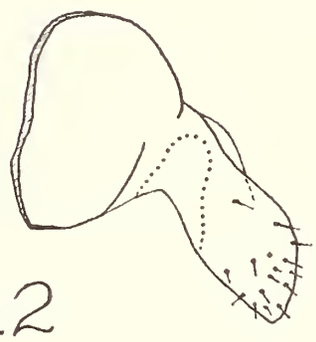

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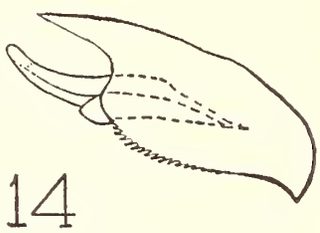

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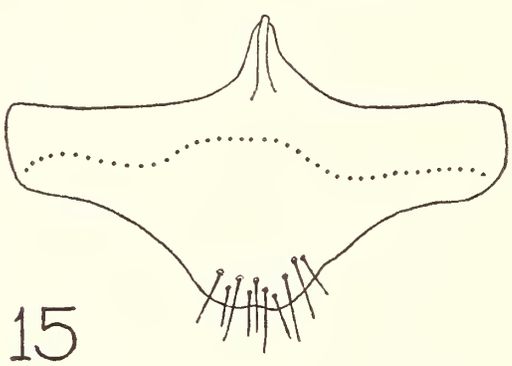

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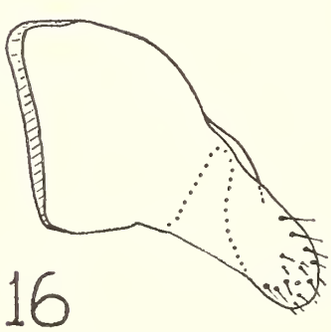

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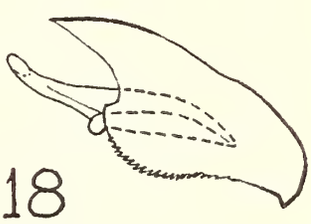

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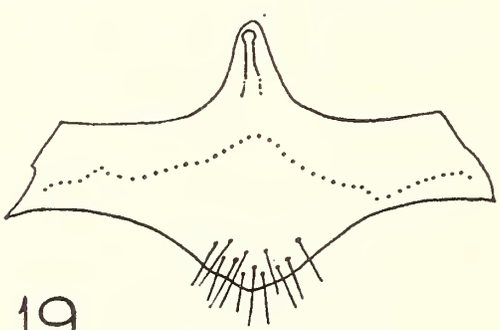

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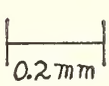

Discussion

The genitalic valves and subgenital plates of all the forms studied show some variations. The greatest variation observed was in the length and curvature of the digitus of the middle valves. This study found only minor variations in the inner valves. However, the angle which the lateral apodeme forms with the inner valves might be a differentiating feature; additional information from more species is needed to resolve this. In future studies of the terminal segments of male ants, the eighth sternum should be examined for each species and subspecies. This structure was examined for *lucidus* and *breviceps,* and a variation in shape was noted. Since the subgenital plate differed in all the forms examined, the configuration of this segment may be a highly important differentiating aid.

Only twice before have studies been made of the genitalic valves and terminal segments of species of *Polyergus.* Clausen (1938) examined and figured the genitalic valves, the ninth and tenth terga, and the subgenital plate of the Swiss species, *P. rufescens.* The segments of this species are similar in shape to those in this study. The outer valve, likewise, has an arciform swelling at the base of the paramere. The configurations of the valves and segments of *P. rufescens* place it close to *P. rufescens breviceps*; however, differences do exist which separate it from the American subspecies, *breviceps, bicolor,* and *umbratus.*

Krafchick (1959) has figured the genitalia and ninth sternum of *P. lucidus,* and the observations made in this study confirm his. He has also figured the ninth sternum of a specimen identified as *P. rufuscens breviceps* (Pl. XII, 9B). This study does not confirm Krafchick's figure; in fact, his figure does not resemble any subgenital plate reported in this paper. There might

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Explanation of Plate II

The genitalic valves and subgenital plates of the subspecies of *Polyergus rufescens.* All outer valves are viewed laterally, the middle and inner valves medially, the subgenital plates ventrally. All figures drawn to the scale indicated. Figs. 8–11, *P. rufescens breviceps.* Fig. 8, Outer valve. Fig. 9, Middle valve. Fig. 10, Inner valve. Fig. 11, Subgenital plate. Figs. 12–15, *P. rufescens bicolor.* Fig. 12, Outer valve. Fig. 13, Middle valve. Fig. 14, Inner valve. Fig. 15, Subgenital plate. Figs. 16–19, *P. rufescens umbratus.* Fig. 16, Outer valve. Fig. 17, Middle valve. Fig. 18, Inner valve. Fig. 19, Subgenital plate.

be a question of determination of the specimens since Krafchick reports that his specimen was collected in Illinois, whereas Creighton (1950) places the distribution of this subspecies in the Rocky Mountain region. Another explanation might be that *breviceps* is a complex.

SUMMARY

The genitalic valves and terminal segments of *Polyergus lucidus* Mayr, *P. rufescens breviceps* Emery, *P. rufescens bicolor* Wasmann, and *P. rufescens umbratus* Wheeler are described and figured. The position and arrangement of the genitalia and terminal segments correspond to the typical pattern previously reported for other members of the Formicinae.

The ninth and tenth terga of the terminal segments and the basal ring of the genitalia show no variations. The inner genitalic valves show very minor variations, while the outer valves show some differences in shape.

The middle valves are the most heavily sclerotized, and the length and curvature of the digitus is distinctive. The moderately sclerotized, subgenital plate differs markedly in shape. Together, the configuration of the genital plate and the middle valve can be used as a means of identification.

Comparisons are made with the genitalia and terminal segments of the few other reported species of *Polyergus*. This study reveals that distinctive differences in the male genitalia and terminal segments can serve as useful adjuncts in classification for members of this genus.

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